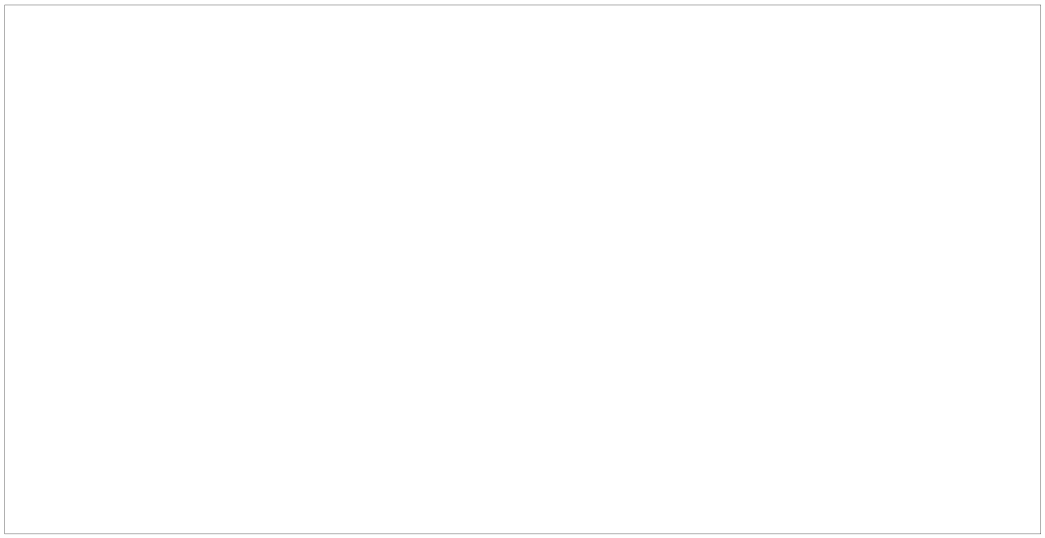

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Present Conditions of the Shanghai Private Machine-tool Industry and Its Problems

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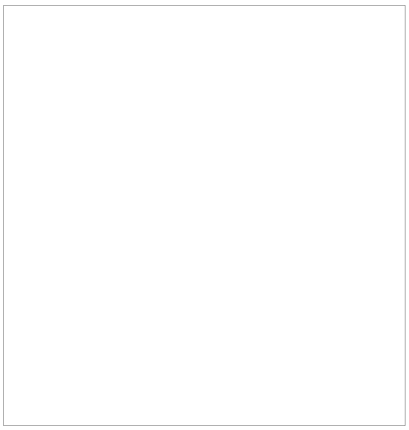
Shanghai, 15 June 1950



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PRESENT CONDITION OF SHANGHAI'S PRIVATE MACHINE-TOOL-~~BUILDING~~ INDUSTRY AND ITS PROBLEMS

Chang Chin

I. INTRODUCTION

When the National Machine-building Industrial Conference convened last March in Peking, the Industry Division of the East China Military and Political Control Committee showed to the conference some of the machine tools produced in Shanghai. The general opinion was that although these machine tools are not entirely up to standard, they are the best machine tools which can be produced in China. Hence it was believed that the manufacture of precision machine tools should be an objective to be fulfilled by Shanghai's machine-building industry.

Indeed, Shanghai's machine-tool-building industry has a long history, and possesses a number of experienced technicians and skilled workers. Some of the plants are owned by persons who were formerly workers; by their efforts they succeeded in building the foundation of machine-tool-building industry despite poor facilities and the unstable market of the past. Although such a foundation is relatively weak, we must preserve it dearly and use it as a basis for future development.

Like the machine-building industry, the machine-tool-building industry, except for plants owned by the state, generally lacked sufficient capital, its facilities were poor, and its products, though diverse, were poor in quality. Shanghai's machine-tool-building

industry depended in the past on light industry, particularly the textile industry; repair shops in textile plants usually became the principal customers to the industry. Seventy percent of the machine tools produced by plants in Shanghai was sold entirely to textile plants 2 years prior to the liberation. Owing to the nature of the demand, machine tools produced in Shanghai were mainly of light weight, medium or small size, and consisted mostly of lathes, drills, crank shapers, and others. Buyers did not demand high-quality goods because most of their purchases were used in repairing.

As a consequence of the liberation, the course of economic development has taken a great change. The government lays great emphasis on the development of heavy industry and transportation, and hence expects many things of the machine-tool-building industry. In essence, we are no longer satisfied with light machine tools such as lathes and drills; we need heavy mining and road-building machines, boring machines, planers, milling machines, grinding machines and others. We also call for higher quality. However, these objectives have not yet been fulfilled by Shanghai's machine-tool-building industry because it did not make proper preparation.

In the Soviet Union, mechanization of labor is considered to be the basic policy in all lines of production, and machine-building industry the key to all other industries. The USSR's machine output multiplied by 35 times in the period from 1913 to 1940, and her machine-tool output also increased rapidly. Undoubtedly, China is going to be industrialized in the future; hence the Heavy Industry Department of the Central People's Government ordered industrial

machines for the second half of 1950 amounting to the equivalent of 900 million catties of rice, or 40 percent of the potential capacity of the public and private machine-building plants for the second half of 1950. In the light of actual needs, this investment is not very large. Because Taiwan has not been liberated, agrarian reform has not been carried out in much of our territory, and grave famine has not been kept under control, we cannot expect the government to develop the machine industry at the same ideal speed as in the Soviet Union.

Although Shanghai's machine-tool-building industry is still confronted with many difficulties arising from business depression, we are sure that it is going to get through all right; and the most pressing job for it to do now is to improve its products and cut costs down by conscious reforms.

II. PRODUCTION CAPACITY

Owing to the diversity and unsteady demand for machines in the past, industrial machines produced in Shanghai covered a wide range while quality was not high. This is also true of the machine-tool-building industry -- there are a considerable number of plants which produced machine tools, but only a few of them specialized in that field and very few made any further specialization.

According to data gathered after the liberation, Shanghai has 30 to 40 plants which are not specialized in machine-tool building, but which constantly put out some machine tools. Less than 10 plants are rated as large plants, i.e., plants having 100 workers or more; the rest of them are very small plants. Products by the large plants of course are better in quality. The small

plants have the advantages of higher efficiency -- the owners or managers are from the working class and have good experience; expenditures are not extravagant, and products usually have some special good features. The large plants we mentioned above are the Min-ching, the Chung-hua, the Ta-tung, the Ta-chung-yuan plants, the Heng-hsin Company, the Chiu-ching, the Hsin-yi, and the Liu-ho plants. The small plants with some specializations include the Ching-yieh (Gear-hobbing machines), the Cheng-chung (grinding machines) and the Tai-chih (drills) plants.

(1) ESTIMATED YEARLY PRODUCTION

Machine	Size	Estimated Yearly Production
Lathes	Small	300
Lathes	Medium and large	200
Milling Machines	Medium	60
Planers	Small and medium	20
Crank Shapers	Large and medium	70
Upright Drills	Small and medium	250
Turret and Capstan Lathes	Small	30
Grinding machines	Small and medium	30
Gear-hobbing Machines	Medium	20
Radial Drills	Medium	70
Punches and Presses	Medium	70
Others		60
Total		1,140

(2) RAW MATERIALS USED IN SHANGHAI'S MACHINE-TOOL-BUILDING INDUSTRY (YEARLY)

	(tons)
Pig iron	4,000
Steel alloys	200
Tool steel	150
Miscellaneous Steel	1,000
Copper	250

(3) Machine Tools Available -- approximately 1,500 units

(4) Number of Workers and Employees -- 2,500

III. TYPES OF PRODUCTS

Following are the major products of Shanghai's machine-tool-building industry:

(1) Engine lathes -- Distance between centers ranges from 4 to 18 feet; height of centers, 4 to 18 inches; take-off belt drive systems or gear systems are used (larger plants are equipped with geared lathes); speed steps range from 6 to 12. Power of various sizes of lathes: the 6-foot lathe has a 2 horsepower motor, 8-foot has 3 horsepower, 10-foot has 5 horsepower, and 12-foot 7½ horsepower motors. Precision standard has almost reached Schlesinger's Limit, except for some defects in the pitch of the lead screw and twisting of the bed.

(2) Turret and capstan lathes -- Size is 6 feet or less, height from table to line of centers ranges from 4 to 6 inches. They are produced by the Min-ching and Hsin-hsing plants and the Liu-ho Metal Plant. Turret lathes produced by the Hsin-hsing Plant and the Liu-ho Metal Plant are imitations of English Ward model and are the best products produced in Shanghai.

(3) Crank shapers -- Length of the stroke ranges from 7 to 28 inches. The 24-inch shaper produced by the Min-ching Plant is an imitation of latest American design; and the 24-inch and 20-inch lathes by the Ta-tung Plant are after the English Butler type which has 8 speeds with 120 strokes per minute at maximum. The Heng-chih, the Tai-chih, and the Yao-hsing-chang plants also produced shapers, the standard of which has reached or is about to reach the Schlesinger Limit.

(4) Milling machines -- Manufactured at present only by Ta-chung-yuan Plant and Heng-hsin Plant. Sizes consist of No 1 to No 3. Design seems very old and has only 6 speeds. Principal tools such as dividing head and others have not reached the precision standard. One plant can produce milling machines of a precision 100 percent over and above the Schlesinger Limit. Due to poor facilities, it was not easy to produce a milling machine. The Ta-tung Plant is beginning the production of vertical milling machines which are of the No 1 type, table size 14 by 52 inches.

(5) Grinding machines -- Output is relatively low. Present grinding machines produced in Shanghai include the 10 by 24 inch size by Ya-chung Metal Plant, the 12 by 30 inch size internal

grinding machines produced by Hsin-hsing Plant (jointly owned by state and private capital), and the Brown and Sharpe No 3 internal grinding machines and tool-grinding machines produced by the Hung-kiang Machine-building Plant.

(6) Vertical drills -- Designs of vertical drills vary from the bench model to the heavy 2-inch type. Most of the bench models imitate the American Altas design. Other models use drive pulley or electric motor installed in the base of the drill. Tai-chih has the longest history in producing vertical drills; the state-owned Chin-mei Company also produces drills.

(7) Radial drills -- Few radial drills are produced. Some plants have tried to produce them in the 5-foot size. The Chung-hua Metal Plant was the first plant which produced radial drills. They are manufactured now by the Yao-hsing-chang and the Ta-chung-yuan plants.

(8) Horizontal boring machines -- The 3-inch horizontal boring machine produced by the Chung-hua Metal Plant is the latest design. Other privately-owned plants have not put out any new-type boring machines. Those produced by the state-owned Hsin-hsing Plant are similar to Chung-hua's. It is said that the state-owned Hung-kiang Machine-building Plant is making designs for the production of horizontal boring machines; owing to its good facilities, it is expected that its products will surpass those produced by private plants.

(9) Gear hobbers -- Size from 10 to 144 inches. The 80-inch size is now available, and the 144-inch size is in the process of being produced. Designs follow mostly the German Pfavter. Some gear hobbers have reached the Scheleisinger limit, for instance those produced by the Ching-yieh Plant. The Min-ching, Ching-cheng, and Hsin-yi plants are also manufacturers of gear hobbers.

(10) Planers -- Sizes produced in the past by private plants ranged from 8 to 14 feet. The Hung-kiang Machine-building Plant is now producing the 8-foot size planers. All the planers produced use belts for forward and reverse movement. From an inspection of the 12-foot planer produced by one company, it was discovered that the level of the front table and that of the rear table differ by 0.04 millimeters and the parallelism error between the movement of the cutter and the table surface is 0.07 millimeters. The guides on both sides of the feed box are not parallel. Because we did not have high precision gauges, straight edges, and other test equipment, we have not been able to determine whether the surface of the machined object is precision finished; we believe that they have not reached Schlesinger's Limit, although they work well. Motors used in planers are very small. For instance, the 8-foot planer is equipped with a motor of 3 to 5 horsepower, the 12-foot with 5 to 7½ horsepower. Body of the planer is not very heavily built; it weighs only half as much as the imported planer of the same size (the old belt-conveyor type) and is far more light than the new vertical planer; the horsepower of its motor is less than one half of the latter.

(11) Punches and presses -- Shanghai produces various types of punches and presses, including punch presses and drawing presses. They are manufactured by the Chung-hua Metal Plant, the Min-ching Plant, and the Pi-yuan Metal Plant.

(12) Metal engraving machines -- Various metal engraving machines such as line-engraving machines, circular engraving machines and others are produced by the Hsing-hsing Company and Ko-neng Company.

(13) Others -- Power saws and slotting machines of medium and small sizes are also produced in Shanghai.

From what we have said above, we know that Shanghai produces a great diversity of machine tools. But only some of the machine tools such as lathes and milling machines are of good quality. The types, sizes, and qualities of these machine tools are suitable for repair shops and small-size machine-building plants only.

IV. IMPROVEMENT OF PRODUCT QUALITY

Since machine tools are the basis of machine-building industry, the quality of the machine tools must be maintained at high level even if at high price. Problems and solutions related to the improvement of product quality are the following:

(1) Types and designs -- We know from our discussion that out of the diverse variety of machine tools produced in Shanghai, only the crank shapers by the Min-ching Plant, the horizontal boring machines by the Chung-hua Metal Plant, and the grinding machines by the Hsing-hsing and Hung-kiang plants are better in

quality; the rest of the machine tools are very backward in type and design. For instance, the lathe, one of the best products we can produce in great quantity, was believed to be too slow in speed by Soviet experts when it was exhibited recently in Peking (the speed of the spindle in the 6-foot or 8-foot lathe is only 600 revolutions per minute while that produced in the USSR is more than 1,000 revolutions). Furthermore, the engine used in the lathe was considered too small while the body weight of the lathe was also considered inadequately light. Such criticism can be applied to virtually all the machine tools produced in Shanghai. They are suitable only for use in repair shops but not in machine-building plants; and in view of their slow speeds and light weight, they cannot use tools made of high-speed steel, not to mention carbide tools. Knowing these shortcomings, several plants are trying to develop new designs. This seems to be the most difficult job since we don't have enough engineers. To copy designs made by foreign countries is not an easy matter either, because we don't have the necessary equipment to make the imitations. The only thing we can do is to select several machine designs which are less complicated but suitable for our own use in the coming years and copy them with modifications made in the light of our limited equipment.

(2) Precision -- There is a tendency to adopt the Schlesinger limit as the precision standard throughout China. Only a few plants in Shanghai put out products which can reach (if not completely) the Schlesinger limit; a majority of them cannot reach it. This is because: (1) seasoning [sic! English given in original. Annealing?] is inadequate, and (2) there is

a lack of good machine tools such as planers, milling machines, boring machines, gear hobbers, etc. According to this author, not a single plant in Shanghai is equipped with a foreign made, large precision planer; (3) there is also a lack of test equipment such as gauges, surface plate, straight edges, precision squares, etc.

The machine-tool-building plants should purchase or produce by themselves more precision test instruments and use these instruments to adjust and repair their own machine tools. If possible, they should spend some money to buy part of the machine tools such as planers, grinding machines, and gear hobbers from abroad. This may use up some foreign exchange, but it is worth while in the long run.

In purchasing machine tools, we should know that not all machine tools follow the Schlesinger limit, a standard that even some of the foreign producers cannot reach. Thus we may modify the standard on the basis of actual needs. Some buyers have gone too far in demanding that the gear hobber they purchased conform to a rigid standard and that inspection be made only when the machine is delivered to them.

(3) Problems of heating, quenching, and raw materials -- Most of the machine-tool-building plants in Shanghai do not have foundries of their own, and hence most of the castings are made in foundries outside the plants. Consequently they have no control over the quality of their orders; for instance, the castings sometimes may have cracked joints, pittings, or be too soft. At present, we are satisfied that the castings have no pitting. However, the

hardness of the castings reaches only Brinell 100 to 150, which is too soft to be used in making carriages of machine tools. Seasoning [sic] of castings also presents a number of problems; natural seasoning takes too much time, yet on the other hand, most casting plants have no adequate furnace facilities.

Principal gears and wheels are made of locomotive wheels with carbon content from 0.35 to 0.5 percent; or sometimes from cast iron. Quenching facilities are lacking at present; attempts to provide better quenching facilities have not been successful owing to insufficient capital and raw materials.

Basic materials for making machine tools include (1) semi-steel, (2) special processed iron such as mechanite cast iron, alloy cast iron, etc., and (3) common cast iron hardened by the chill method or the oxygen torch. These materials are used by industrially advanced nations; we should study how to use them efficiently.

(4) Spur gears -- Most of the spur gears used in Shanghai are produced by gear hobbing machines; among the hobbing machines used in Shanghai, only the two made by Germany meet the precision standard, but they have been in use for too long; the rest of them are below standard. Shanghai is badly short of gear hobbing machines. Most of the gear cutters are American, English, or Japanese made. There is also a shortage of gear cutters. Although gear hobbing machines are operated by skilled workers, the machines always make excessive noise because the engineers and technicians were not well-trained in using them.

Actually there are a number of non-machine-tool-building plants which have the equipment for making spur gears; most of this equipment is idle. We should seek to use it.

Because quality improvement is our foremost task, we have adopted rather high standards in our above discussion. It is to be noted that the present difficulties arise mainly from the various socio-economic circumstances of the past which were unfavorable to the development of heavy industry and the growth of technical skill; for instance, the slow market for machine tools, and the inflation which did not provide incentive for technical improvement, etc. The situation has changed since the liberation; the few plants which have better equipment are carrying out various reforms. They possess excellent technicians and skilled workers and have accumulated valuable experience; these two factors combined are assets more valuable than the plant equipment. Upon such a foundation, it is expected that the technical level of Shanghai's machine-tool-building industry will be greatly enhanced.

V. REDUCING PRODUCTION COSTS

Many people feel that prices for Shanghai's machine tools are too high. This is true. For instance, a 6-foot feed-box engine lathe costs 40 or 50 million yuan; a good 24-inch planer 50 million yuan, and a top-quality crank planer 100 million. Since these machine tools are sold at prices almost as high as those imported from Britain or the US, why do the manufacturers still find these machines only barely profitable?

First, the manufacturing of machine tools requires highly skilled labor who command rather high wages; this high-wage labor cannot be replaced by apprentices. This situation is different from what it is in the manufacturing of other types of machines.

Second, the size of most of the machine tool manufacturing plants is too small and hence overhead cost is high (there are only 70 or 80 large plants, each of which has only about 100 workers); besides, because the market demand for their products is not steady, they find it difficult to specialize in a few choice products which may give them comparative advantage.

Third, production cannot be speeded up because of poor facilities and lack of specialization. The manufacturing of precision machine tools is a very difficult job; under the condition of poor facilities and small scale operation, it consumes a tremendous amount of labor, the amount of which is almost beyond the imagination of outsiders. For instance, to produce an 8-foot engine lathe takes 1,000 hours in the US; to produce a more simple lathe of the same size takes 250 units of labor. It takes 8 to 12 hours to scrape an 8-foot lathe bed and carriage in the US, but 5 or 6 days in Shanghai. This author learned that a plant in Shanghai used more than 300 units of labor to produce a 3-inch horizontal boring machine because it used harder pig iron and because the machine required higher precision. This can hardly be visualized by the machine tool buyers.

In the far cry for industrial reform, simplification and economy seem to be the order of the day. According to this author, the situation in the machine-tool-building industry is somewhat different; that industry has never been "prosperous". In other words, under the strain of many years of business depression, simplification and economy measures have been taken by many plants. In some larger plants, the ratio of employees to workers is about 1:6. On the surface, there seem to be too many employees in relation to workers. Actually this is not the case. For instance, a plant which manufactures annually 20 to 30 types of machine tools, some of which are entirely newly designed, has only 20 employees in its engineering department. Such a small group of personnel is apparently inadequate. Indeed, the engineering staff must be increased in view of the extremely small scale of operation, poor production facilities, excessive diversity of production, and the increasing market demand for various products. Against such a background, the only solution is merger and specialization which will be discussed in our concluding section.

VI. RELATIONSHIP BETWEEN PUBLIC AND PRIVATE MACHINE-TOOL-BUILDING PLANTS

The Vice-Minister Liu Ting of the Heavy Industry Department of the Central People's Government published an article in Peking People's Daily, 14 April 1950, entitled "The First Purchase Order Sponsored by the Heavy Industry Department", in which he said: "Our main objective is to organize production and consumption in the interest of the people. We shall use a centralized goods

purchase system to stabilize and guarantee industrial operation, eliminate blind competition, and gradually introduce production planning." It is predicted that principal orders for machine tools will henceforth be distributed by the government. Many types of products made by the publicly-owned Hung-kiang, Hsin-hsing, Chung-ho, and Ching-mei plants are similar to those produced by privately-owned plants. The privately-owned plants should, by organizing, apply to the government and the publicly-owned plants for a due share in the purchase orders. This is in complete accordance with government's policy of fostering both public and private enterprise.

In section 3 of this article we mentioned the major problems confronting the machine-tool-building industry after the liberation. In order to solve these problems, which are largely technical in nature, privately-owned plants should seek assistance from the publicly-owned plants. Since the latter have better equipment and facilities and competent technicians and engineers, they are in a position to render valuable services to private plants in designing, metal casting, quenching, the use of precision test instruments, etc. Technical cooperation between public and private enterprise is thus one of our objectives.

VII. SOLUTION: MERGER AND PRODUCTION SPECIALIZATION

(1) Over a long period of time, Shanghai's machine-tool-building industry has acquired a good deal of valuable experience; it has a number of highly skilled workers; and it has experience in

producing various types of machine tools.

(2) In the past it mainly served repair shops of light industry; its products have not reached a standard either in types, sizes, or qualities suitable for future heavy industrial reconstruction.

(3) Hence our foremost objective is to improve product quality. This consists mainly in the improvement of design, casting, quenching, spur gears, etc. However, technical improvement cannot be accomplished through individual efforts.

(4) High production cost is caused by high direct cost and slow operation, which in turn are consequences of the small scale of operation, diversity of products, and backward techniques.

(5) With respect to private vs. public industrial relations, private plants must consult as soon as possible with the government plants on production specialization and technical cooperation.

(6) In view of their small capital investment and poor facilities, many privately-owned plants are not quite convinced about going into further production specialization. This is the heart of our problem. Therefore, the best solution would be merger of private plants and closer coordination between private and public enterprises. The government should create a situation whereby the private plants can specialize their production without fear. There is also a need for technical cooperation among the privately-owned plants and between publicly-owned and privately-owned plants, particularly technical cooperation in metal casting, quenching, manufacturing of spur gears and other phases.

This is the correct course for the development of the private machine-tool-building industry.

E N D